Space Weather Forecast

Issued on Saturday, 23 July 2022 at 13:05 Local

This forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: 21 July Coronal Mass Ejection shock arrived at Earth 03Z, subsequent Minor Geomagnetic Storm G1 observed.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was low over the past 24 hours, with isolated small-scale common-class activity observed. The peak flare was seen 23/1002UTC from a sunspot nearing the northwestern horizon. Prior to this, a second small common-class CME was observed at 22/1614UTC, with this tied to a 'prominence eruption' (arc of plasma on the sun's edge) from the southwest, perhaps from the vicinity of a sunspot which is now on the far side. The resulting Coronal Mass Ejection (CME) from this event has been modelled and determined to have no Earth-bound component.

There were six sunspot regions that saw out the period, with a seventh fading near the middle of the sun. Relative to the preceding week, the Sun seems to be undergoing something of a slight lull in numbers of sunspots and their associated activity. Having said this, minor proliferation was observed in the few magnetically bipolar regions. By contrast, all of the unipolar groups were unchanged in the period.

Available satellite imagery in the period suggests there were up to three separate CME-generating events: firstly, the aforementioned prominence; secondly a western hemisphere far-sided event; and thirdly another far side emission from the eastern solar hemisphere. The third of these has yet to be analysed, however any Earth effects are not expected, as modelling suggests for the other events.

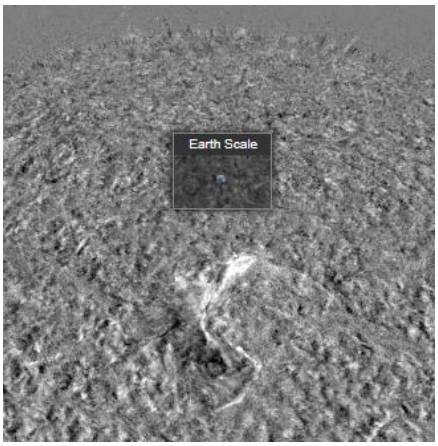

Figure 2: Helioviewer.org-generated 1-hour difference image of extreme UV satellite imagery to 23/0900UTC, showing possible disturbance in a filament. As yet there is no CME attributable to this event, but given its central location, it will be monitored.

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At around 23/0800UTC a disturbance was seen in a 'filament' (arc of plasma on the facing side of the sun) in the northern solar hemisphere straddling the meridian. There was unfortunately no usable ground-based near infrared imagery for this period, however it is possible that a minor 'filament lift off' (a possible CME) occurred from this location. Imagery will be monitored, however there is as yet no sign of ejecta.

Solar Wind / Geomagnetic Activity: The solar wind showed the arrival of at least the shock of the 21 July CME in the period, passing near-Earth measuring satellites at 23/0229UTC, and reaching Earth-based magnetometers at 23/0257UTC. The CME's passage of these satellites precipitated a sudden impulse warning from MOSWOC, which manifested at BGS Hartland magnetometer from 23/0227UTC as a near-instantaneous change in the H-component of 38nT, with a 50nT change seen inside three hours. The solar wind had previously shown a less eventful fast regime tied to a coronal hole high speed stream.

The solar wind speed started the 24 hours at Elevated levels. This changed with the advent of the CME, whereupon an increase to Strong levels was seen briefly before this fell back to earlier trends by the end of the reporting period. The number of particles comprising the solar wind increased to a peak of roughly double background at the onset of the CME, again paring back to more typical levels later in the UTC morning. The magnetic field associated with the solar wind was also within normal background at first, but peaked with the CME, largely returning to its earlier tendency later in the morning.

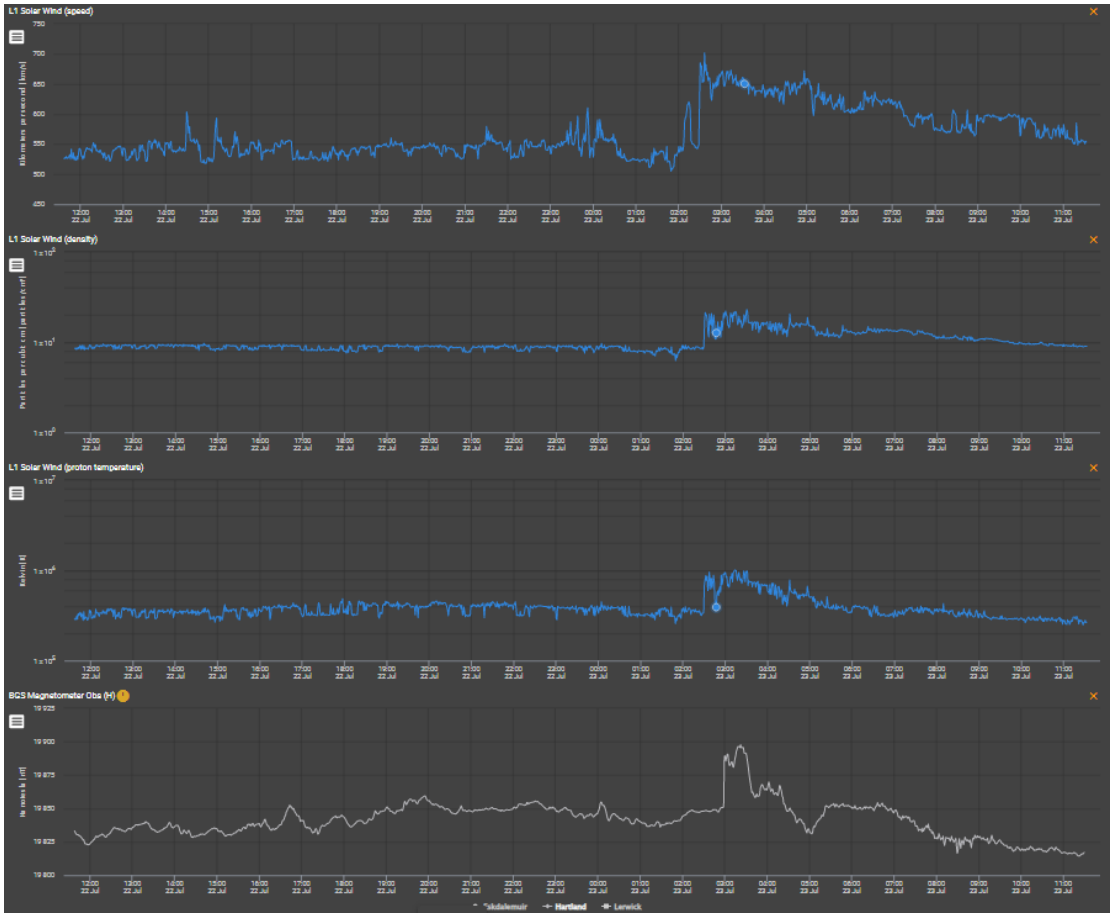

Figure 2: Solar wind speed, density (number of particles) and temperature for the 21 July CME arrival at 23/0229UTC. Also shown is the resultant deflection in a ground-based magnetometer at Hartland, Devon, UK around half an hour later.

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At the time of writing, there has been no progression from a shock-like regime from the CME to the more impactful magnetically dynamic inner portion of the CME. It may be that this represents the sum total of this event, with the core of the CME perhaps passing narrowly behind the Earth in the track of its orbit, however this is conjectural.

The net result of the above solar wind measures was initially provisionally quiet, but increasing to Minor Storm G1 with the CME's arrival.

Energetic Particles / Solar Radiation: No solar radiation storms were observed.

Four-Day Space Weather Forecast Summary

Solar Activity: Activity is expected to remain mainly low, with a slight chance of moderate activity from a number of currently inert regions on the Sun.

Solar Wind / Geomagnetic Activity: The 21 July CME shock arrived at Earth 23/0257UTC and its effects are ongoing, with further Minor Geomagnetic Storm G1 intervals likely for the remainder of day one, Saturday 23 July, becoming a slight chance on day two, Sunday 24 July before fading. No further CMEs feature in the forecast.

The only persistent feature in the forecast is the already mature influence from some western solar hemisphere 'coronal holes', with their influence probably swamped by the 21 July CME for the remainder of their tenure this UTC weekend, decaying to quiet activity into the new working week.

Energetic Particles / Solar Radiation: No solar radiation storms are expected.

Geomagnetic Storms:

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	60	10	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Radio Blackouts - X Ray Flares:

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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